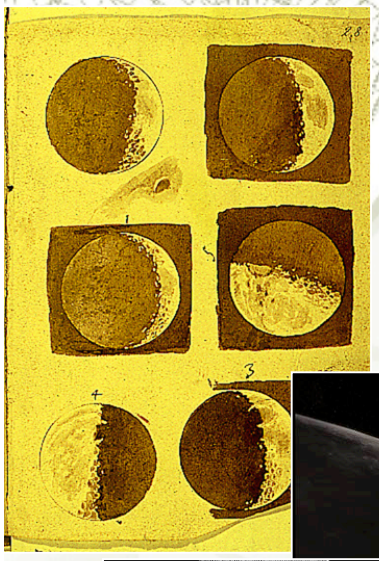
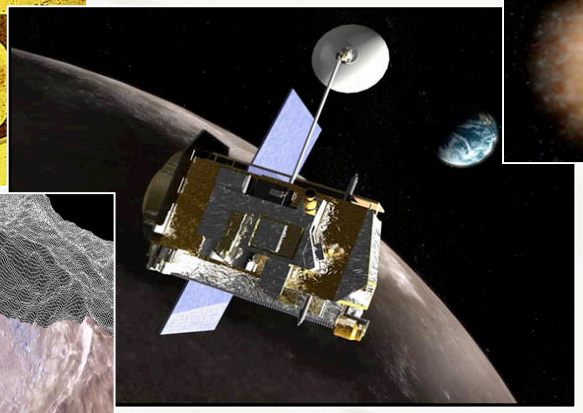
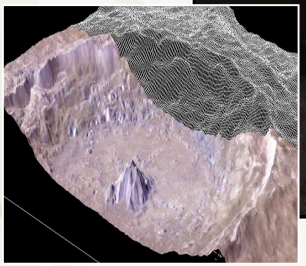
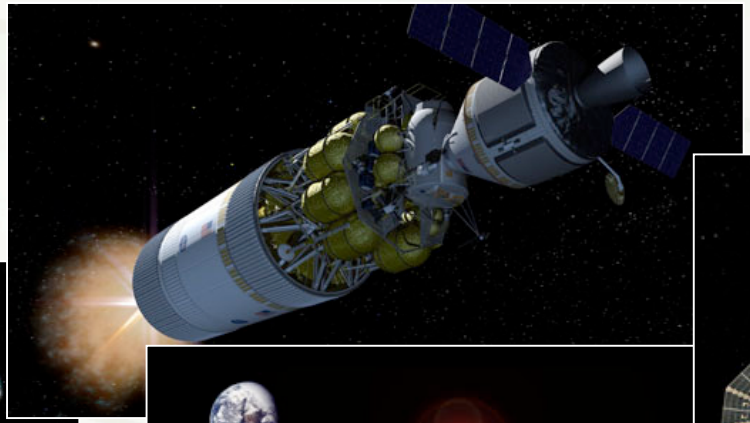
ILIADS: An Integrated Lunar Information Architecture for Decision Support

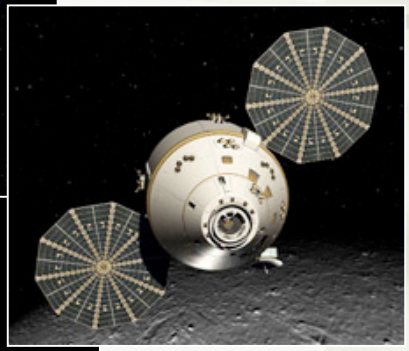
Goddard Space Flight Center

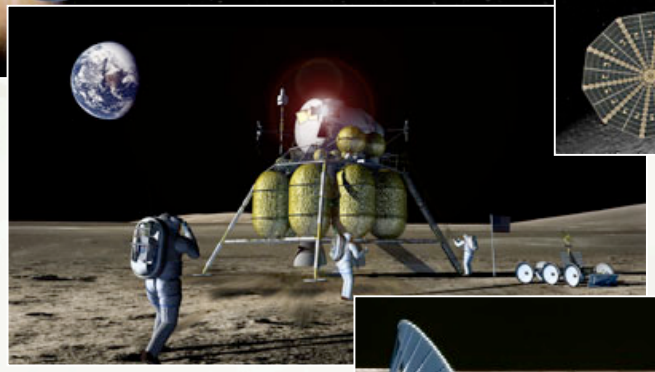


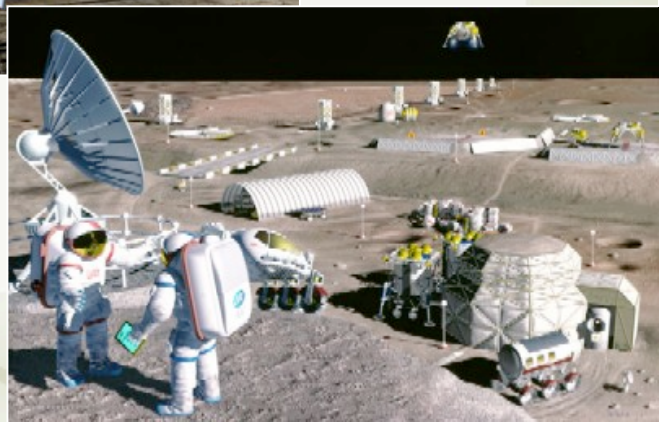








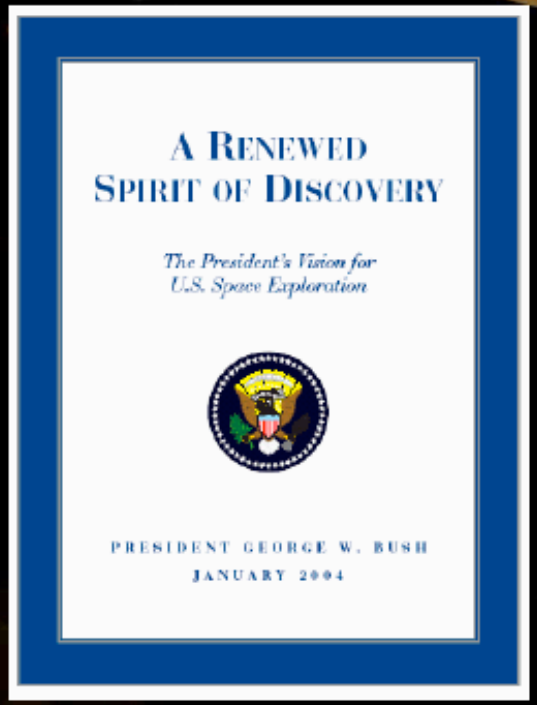




Stephen Talabac
Goddard Space Flight Center
April 21, 2008

A Bold Vision for Space Exploration, Authorized by Congress

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop and fly the Crew Exploration Vehicle no later than 2014 (goal of 2012)
- Return to the Moon no later than 2020
- Extend human presence across the solar system and beyond
- Implement a sustained and affordable human and robotic program
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration



NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

Returning to the Moon: The first step
Lunar Reconnaissance Orbiter (LRO)

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- Being built by NASA/Goddard
- Launch: Fall 2008
- Unmanned mission to create a comprehensive atlas of the moon's features and resources to aid in the design of a lunar outpost.
- Test technologies, systems, flight operations and exploration techniques to reduce risk and enable future missions to Mars and beyond.
- Map the moon in unprecedented detail
- 71GB/day; 26TB/year

LRO Daily Data Estimates				
Data Source	Data Volume per Orbit (Mbits)	Data Volume per Day (Gbits)	Files per Orbit	Files per Day
Spacecraft HK	216.96	2.76	27.1	345.6
CRaTER	617.01	7.86	1.0	13.2
Diviner	274.24	3.49	34.3	459.0
LAMP	73.77	0.94	1.7	22.2
LEND	20.52	0.26	2.6	33.2
LOLA	110.11	1.40	13.8	234.1
LROC NAC	40,423.22	515.13	32.0	407.8
LROC WAC	3,204.43	40.84	3.0	38.2
Totals:	44,940.26	572.69	115.42	1,553.40

LRO Measurements

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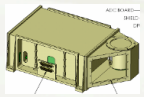
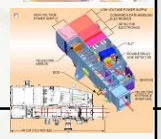
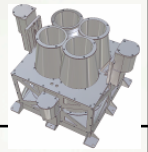
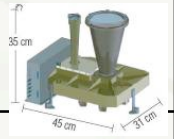
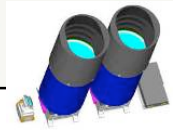
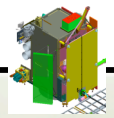
Instrument	Navigation/ Landing Site Safety	Locate Resources	Life in Space Environment	New Technology
CRaTER **Cosmic Ray Telescope for the Effects of Radiation** 			✦ High Energy Radiation ✦ Radiation effects on human tissue	
DLRE **Diviner Lunar Radiometer Experiment** 	✦ Rock abundance	✦ Temperature ✦ Mineralogy		
LAMP **Lyman Alpha Mapping Project** 		✦ Surface Ice ✦ Image Dark Craters		
LEND **Lunar Exploration Neutron Detector** 		✦ Subsurface Hydrogen Enhancement ✦ Localization of Hydrogen Enhancement	✦ Neutron Radiation Environment	
LOLA **Lunar Orbiter Laser Altimeter** 	✦ Slopes ✦ Topography/Rock Abundance ✦ Geodesy	✦ Simulation of Lighting Conditions ✦ Crater Topography ✦ Surface Ice Reflectivity		
LROC **Lunar Reconnaissance Orbiter Camera** 	✦ Rock hazards ✦ Small craters	✦ Polar Illumination Movies ✦ Mineralogy		
Mini-RF ***Technology Demonstration*** 				✦ S-band and X-band SAR demonstration

How will LRO measurements help?

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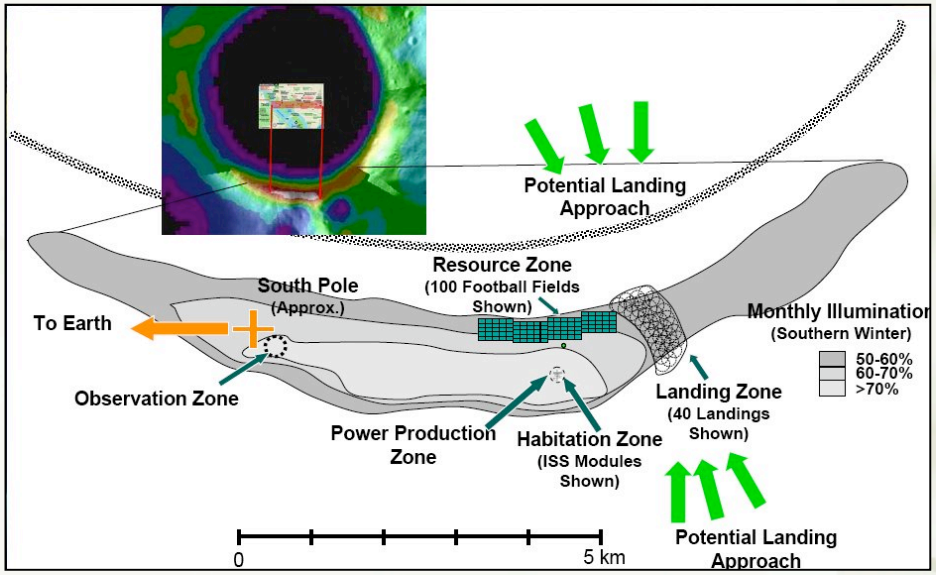
- Building a lunar outpost means spending extended periods on the lunar surface.
- LRO will spend at least one year in low polar orbit collecting detailed information about the moon and its environment.
- LRO focuses on the selection of safe landing sites, identification of lunar resources, and studies of how the lunar radiation environment will affect humans.
- The LRO instrument payload will provide key data sets to enable a safe and productive human return to the moon.



So… what will we need to know?

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- A detailed characterization of the lunar terrain (surface roughness, slopes, …).
  - Where do we want to land and can we land there safely?
  - How must we design rovers to safely traverse the lunar landscape?
- Where should we build an outpost?
  - How do the lunar temperatures and lighting vary with time?
  - Lighting will be critical for solar-based power systems.
  - Will we be able to have direct-to-Earth communications? Will we need a communications relay satellite(s)?
- Where are *in situ* resources located (water ice, titanium, ilmenite)? How can we travel to those locations safely? How can we extract and then process them for our use?
- How will we protect the crew from hazards (lunar dust, space radiation environment, periodic solar storms)?

The need for a lunar information system for decision support

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- The problem today …
  - Existing lunar data are not readily accessible nor easily integrated geospatially
  - Engineers, scientists often spend ***weeks*** obtaining and cross-referencing data from disparate sources

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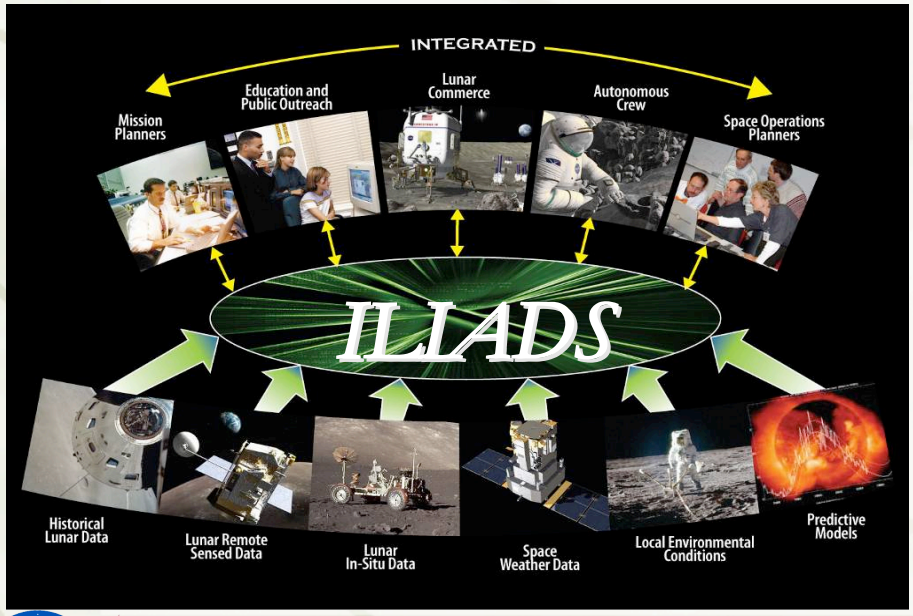
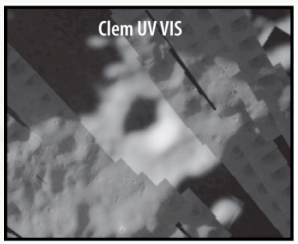
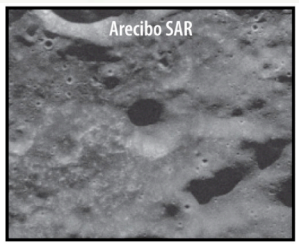
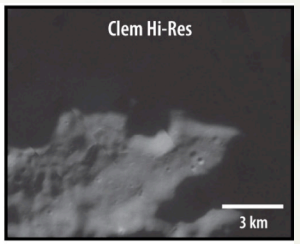
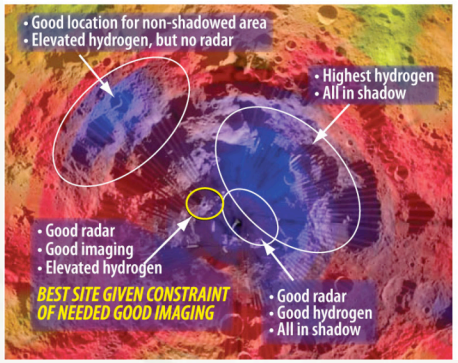
The solution: ILIADS - An extensible core architecture; compliant w/OGC standards; a suite of core and plug-in quantitative analysis functions and models.

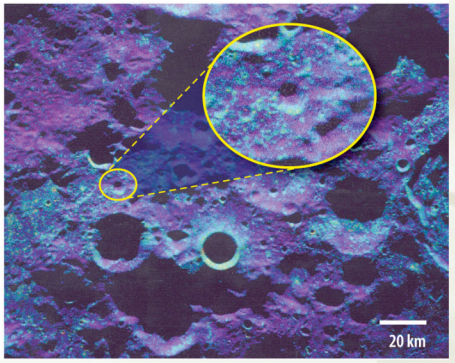












ILIADS: Applied Science for Exploration

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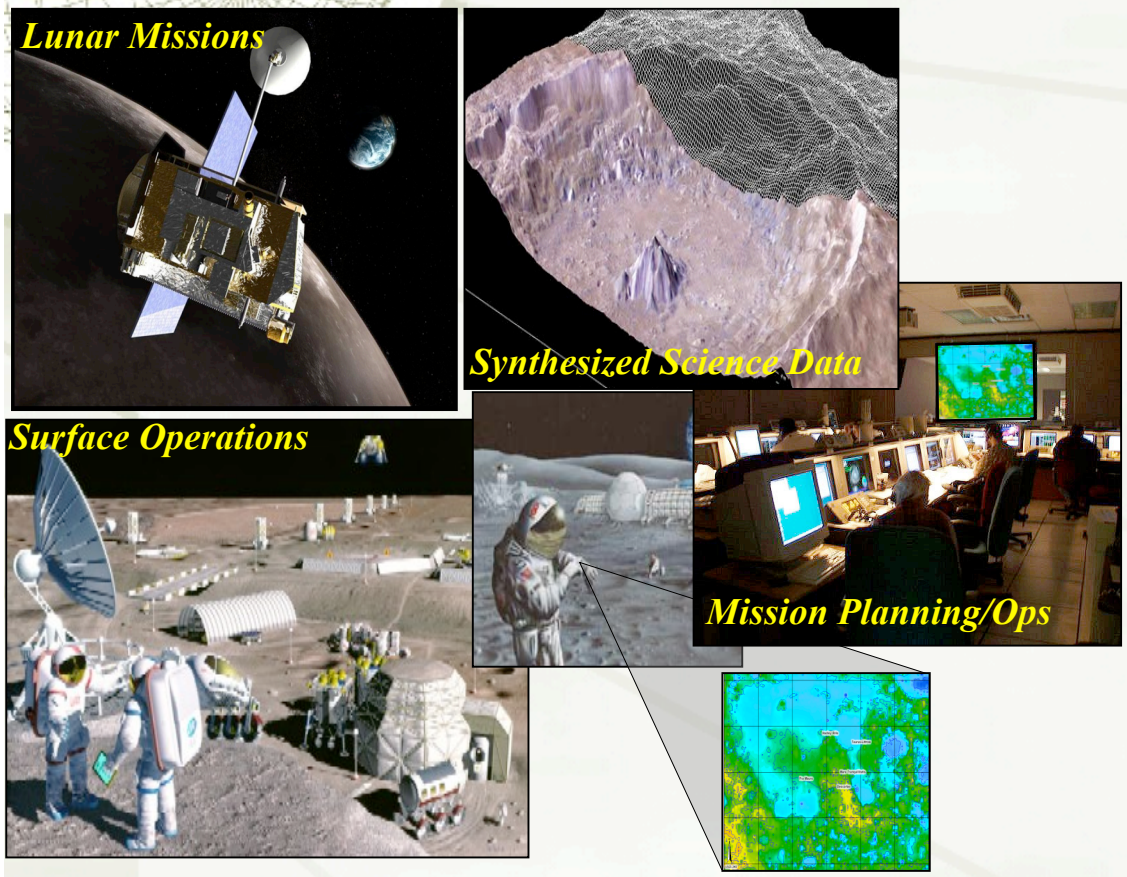
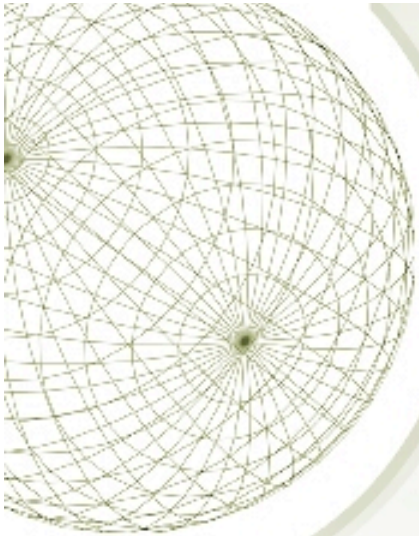


- ILIADS provides easy access to and interoperability with:
  - Geospatially referenced historical and new lunar mission data
  - Environmental models
  - Simulations
- Applicability
  - Mission formulation & design
  - Landing site and outpost/habitat selection; *in situ* resource extraction and utilization
  - Mission operations; plan/conduct EVA sorties …



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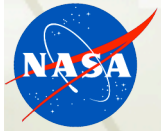
ILIADS Demonstration

Troy Ames
Karin Blank
Goddard Space Flight Center



Backup slides

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LRO - ILIADS

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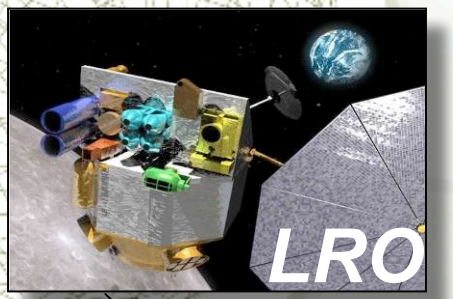
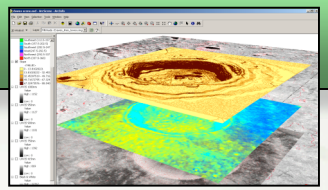


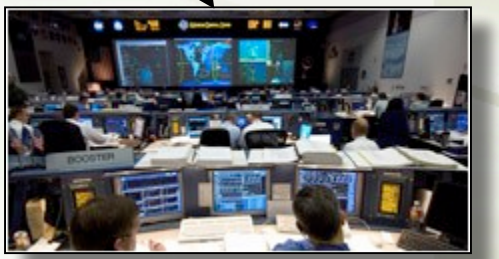
SOCs

- ✓ Image registration
- ✓ Geodetic control
- ✓ Format conversion
- ✓ Data fusion
- ✓ Special product generation
- ✓ Assurance of accuracy

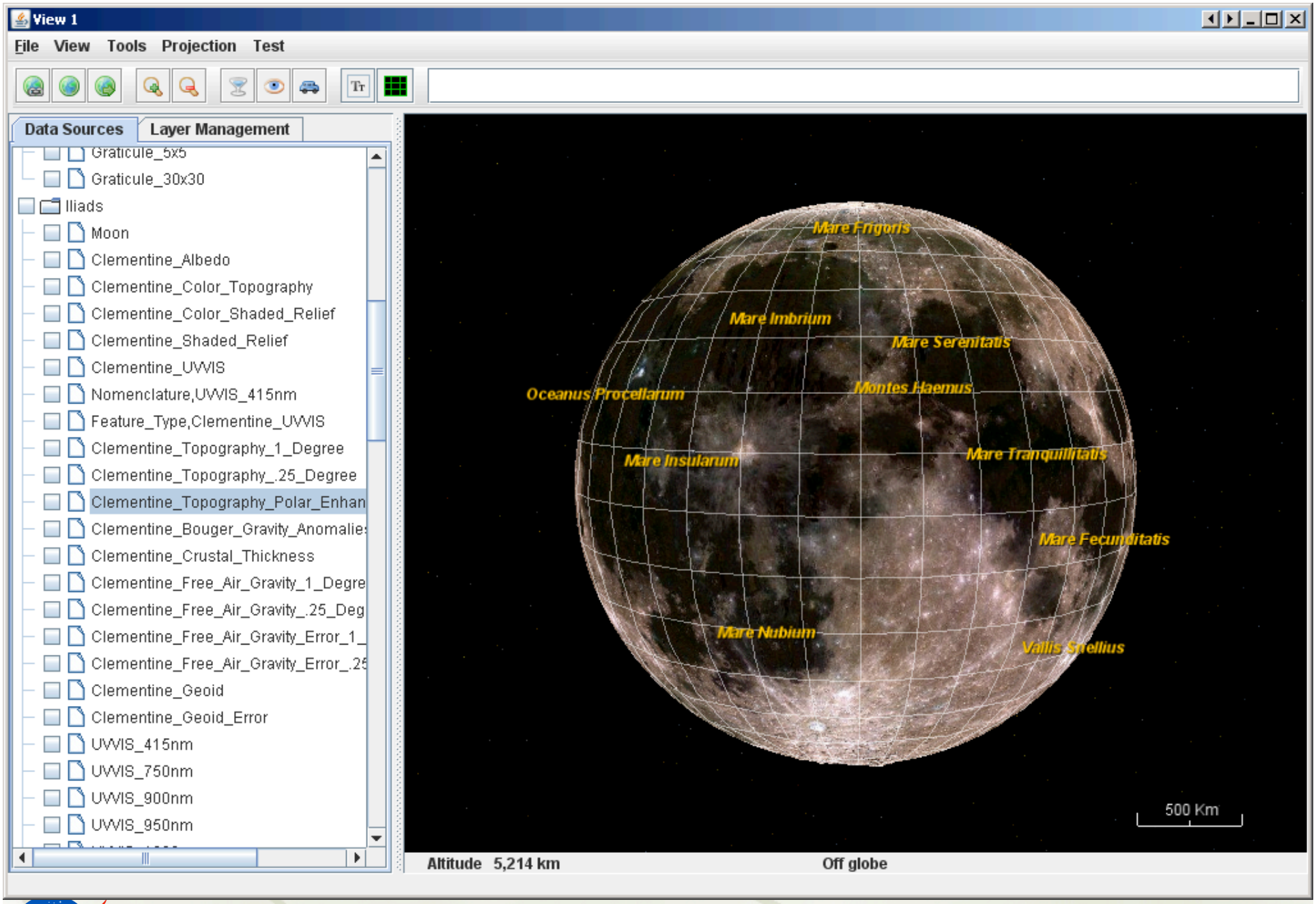
ILIADS



- ✓ Lunar GIS
- ✓ Data Selection
- ✓ 3D Visualization
- ✓ & Manipulation
- ✓ Data Overlays
- ✓ Analytical Tools
- ✓ & Algorithms
- ✓ End User Interfaces
- ✓ & Extensions



Exploration Mission Planning & Ops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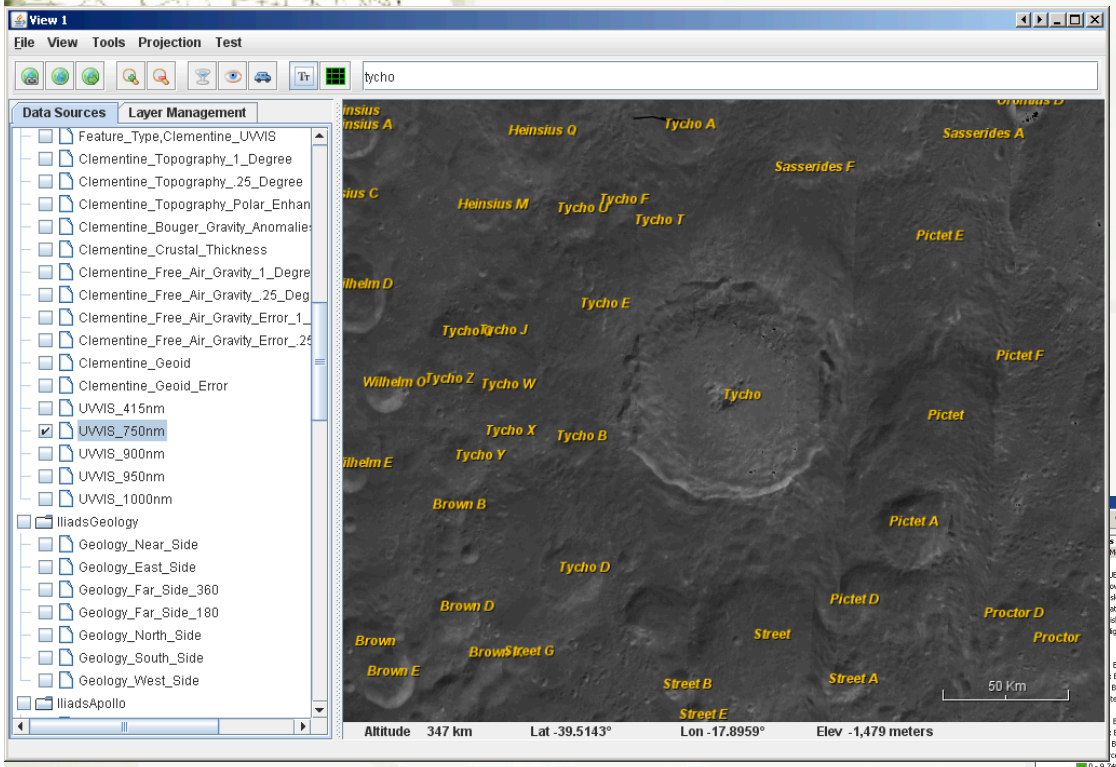
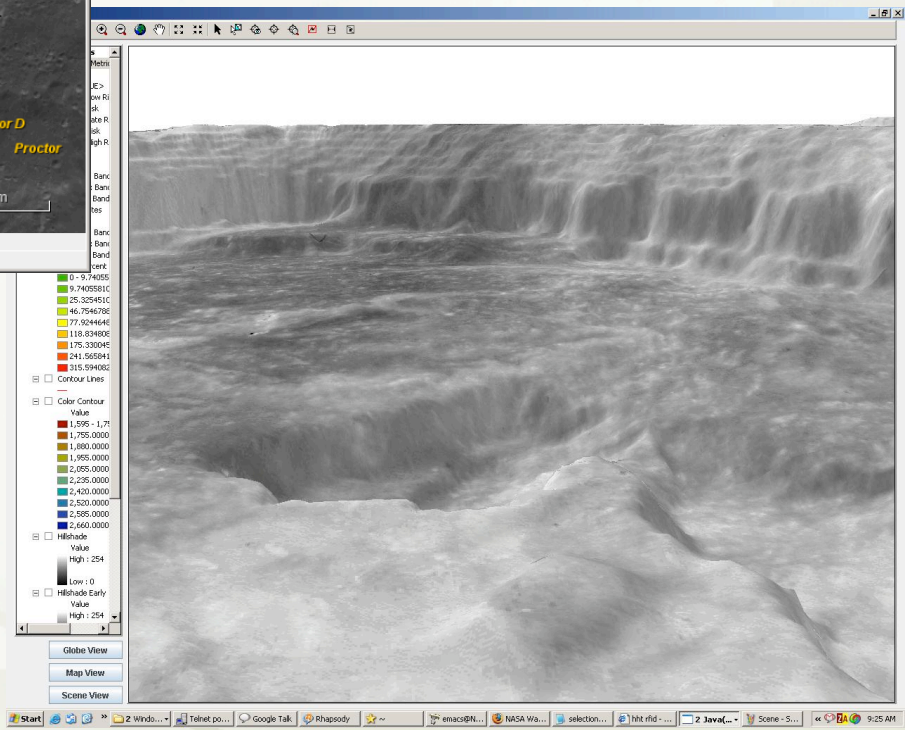
UVVIS_415nm
UVVIS_750nm
UVVIS_900nm
UVVIS_950nm
Mare Frigoris
Mare Imbrium
Mare Serenitatis
Oceanus Procellarum
Montes Haemus
Mare Insularum
Mare Tranquillitatis
Mare Fecunditatis
Mare Nubium
Vallis Snellius
500 Km
Altitude 5,214 km
Off globe





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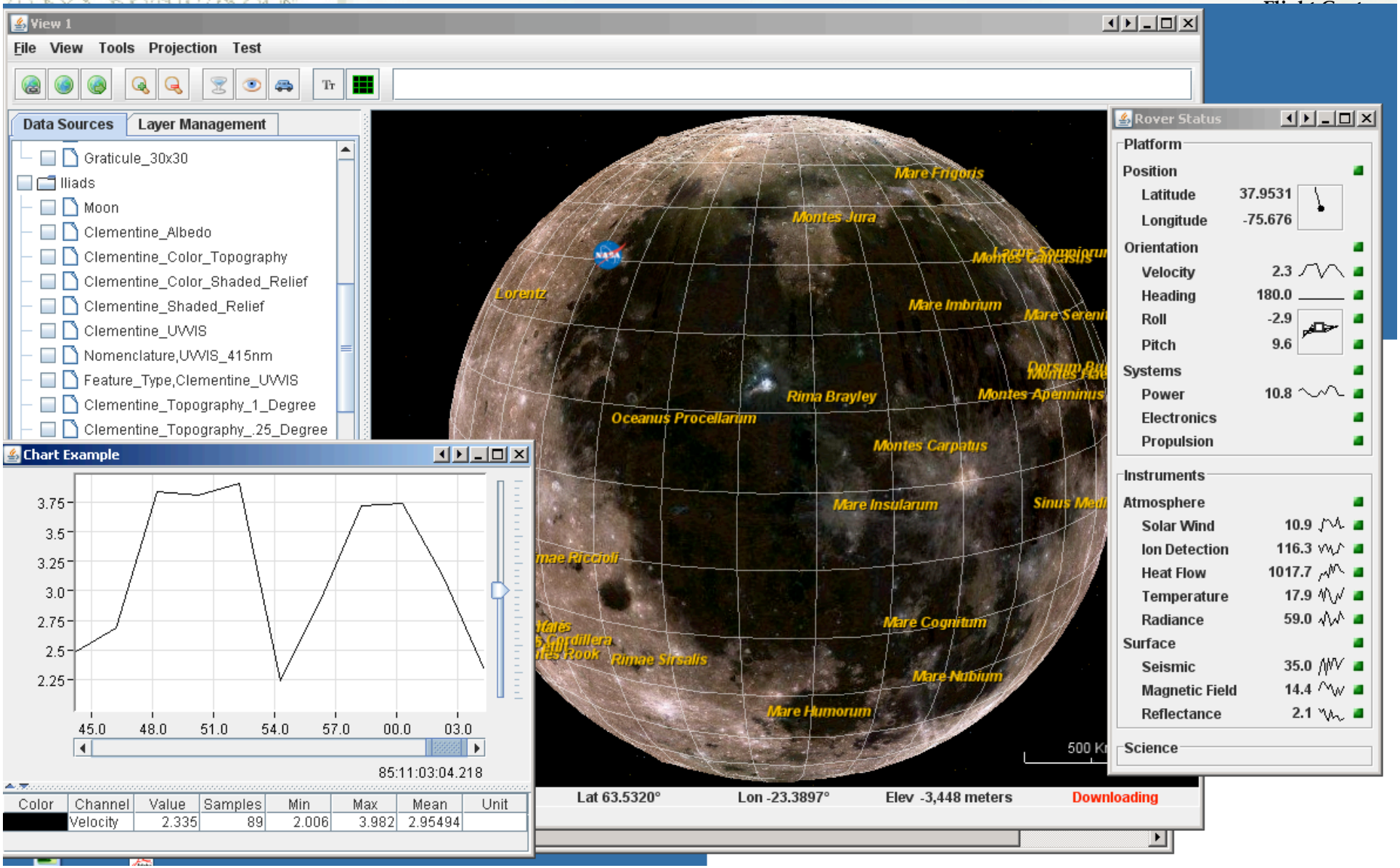
Stephen Talabac
MMO Game Presentation

NASA/GSFC: ILIADS

Lunar asset monitoring

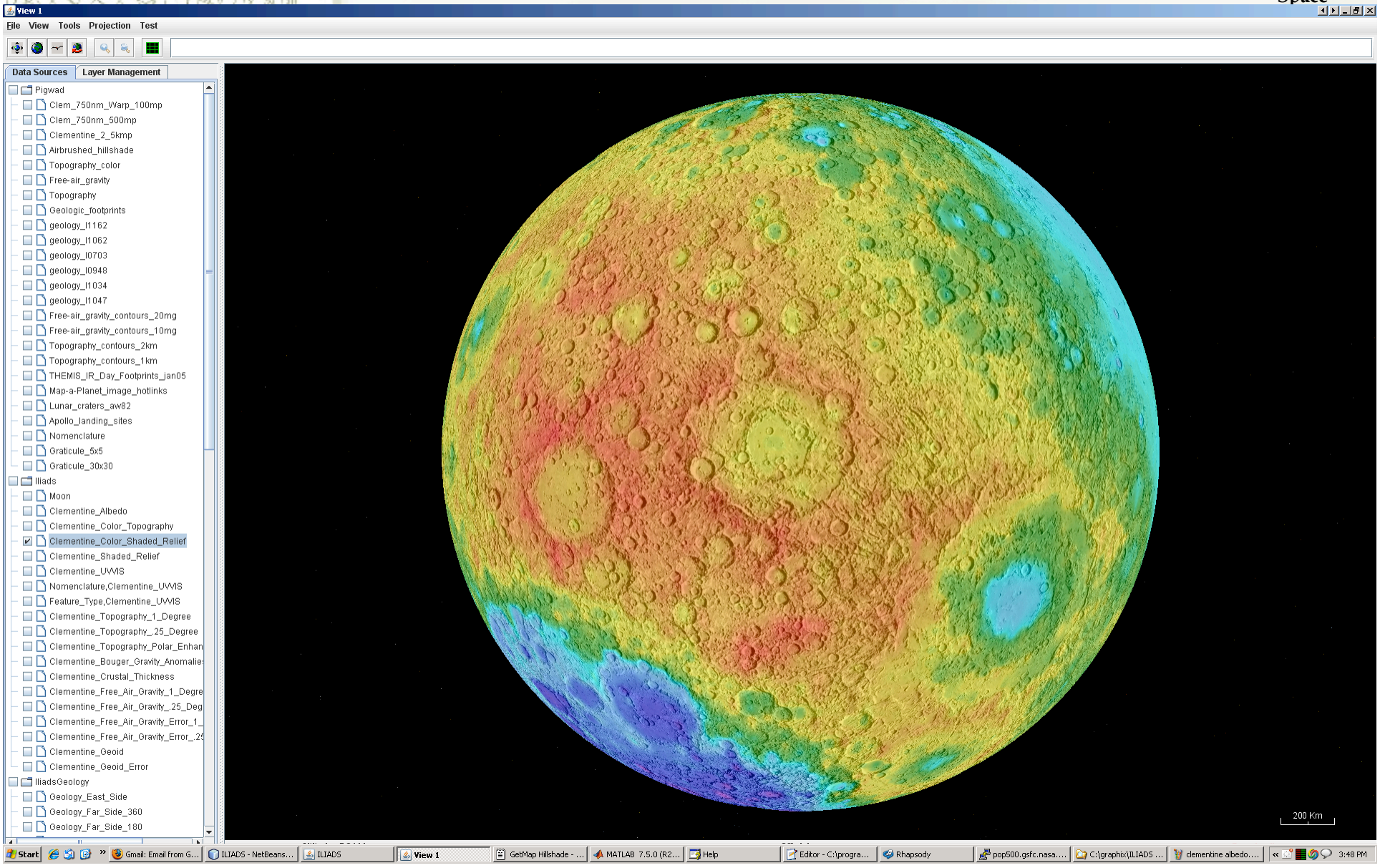
Rovers, habitats, lunar infrastructure elements

Goddard Space

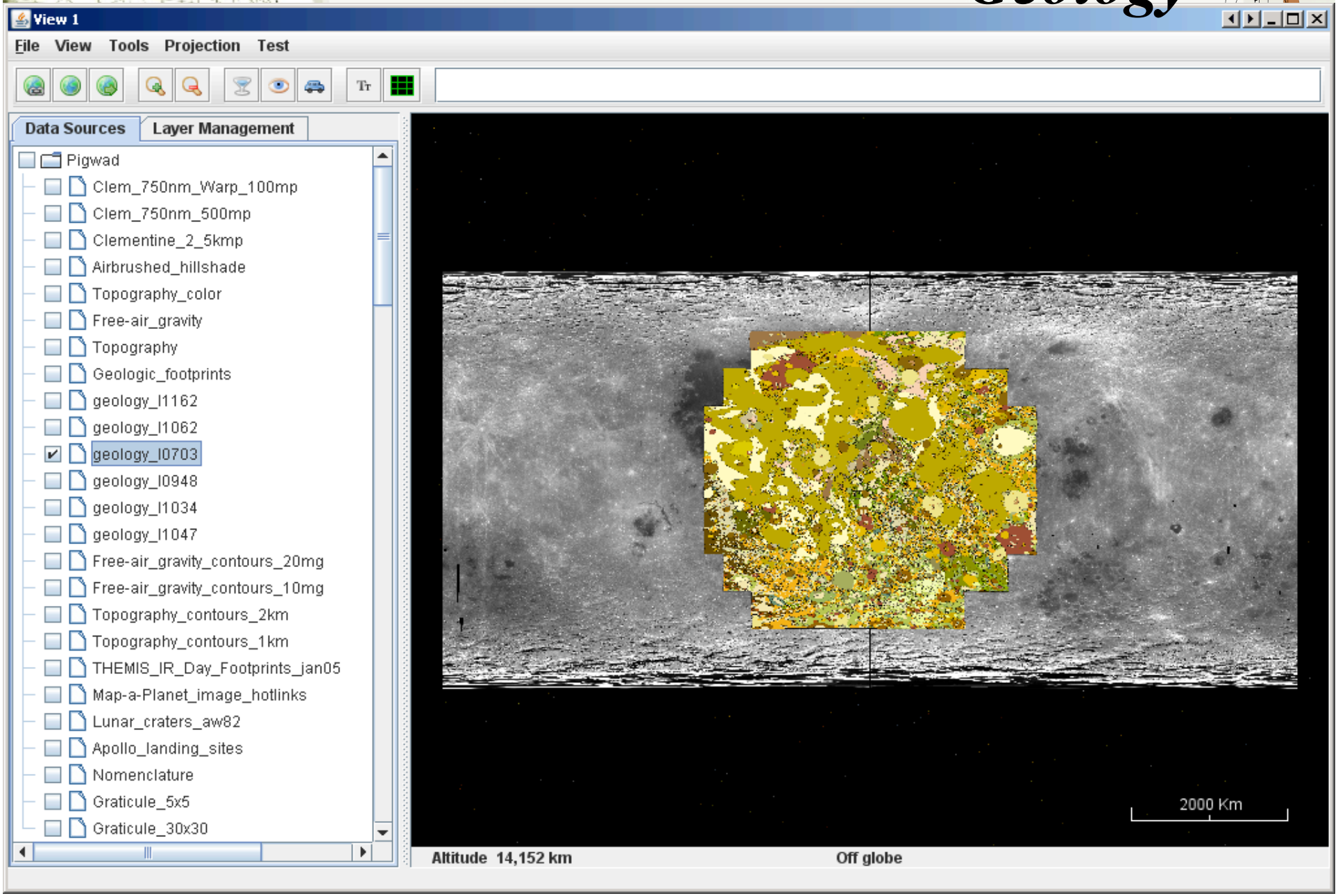


Clementine shaded relief

Goddard Space



Geology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Topography_color
Free-air_gravity
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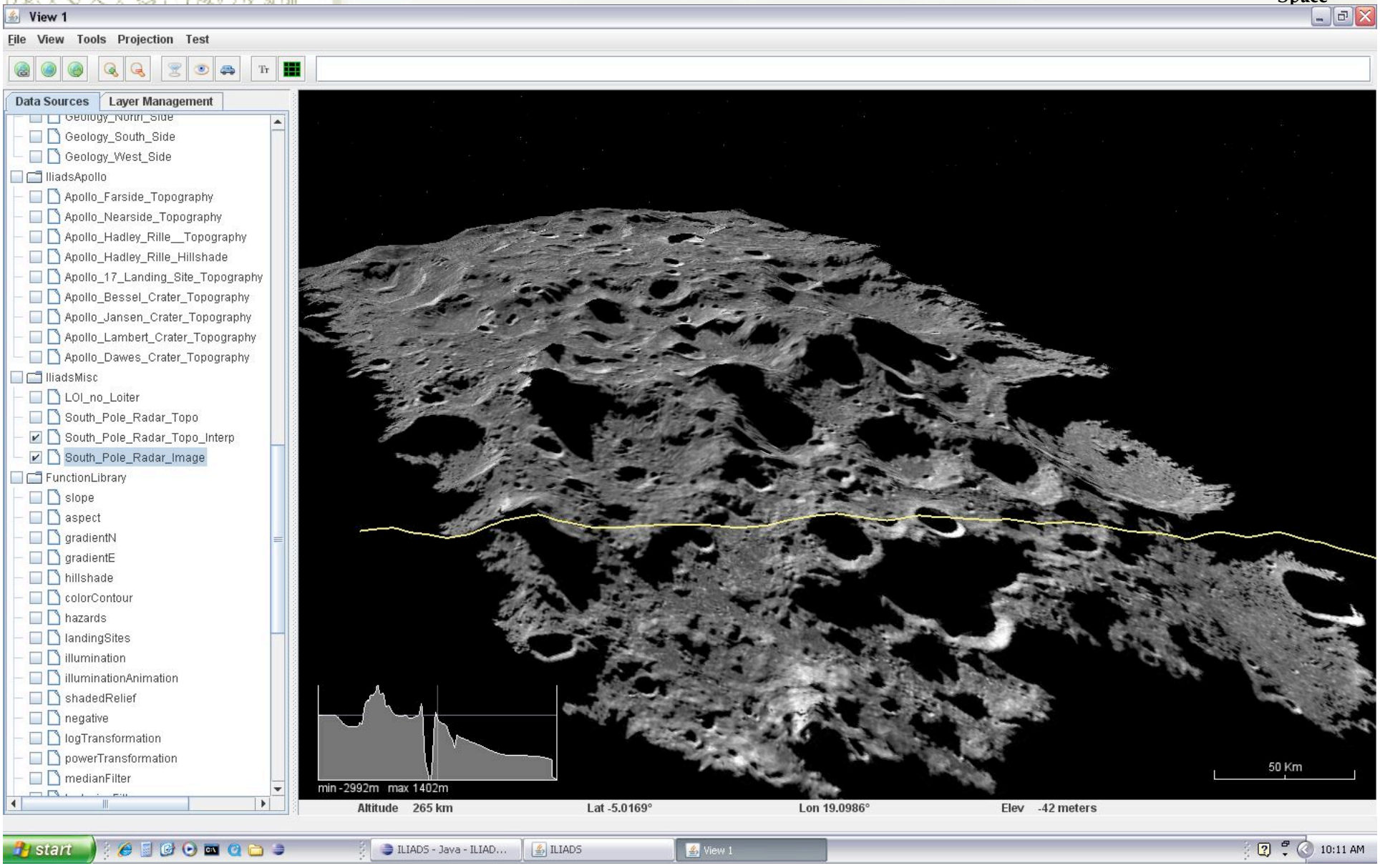
Altitude 14,152 km
Off globe

Goldstone south pole radar data

Goddard Space



Illumination analyses

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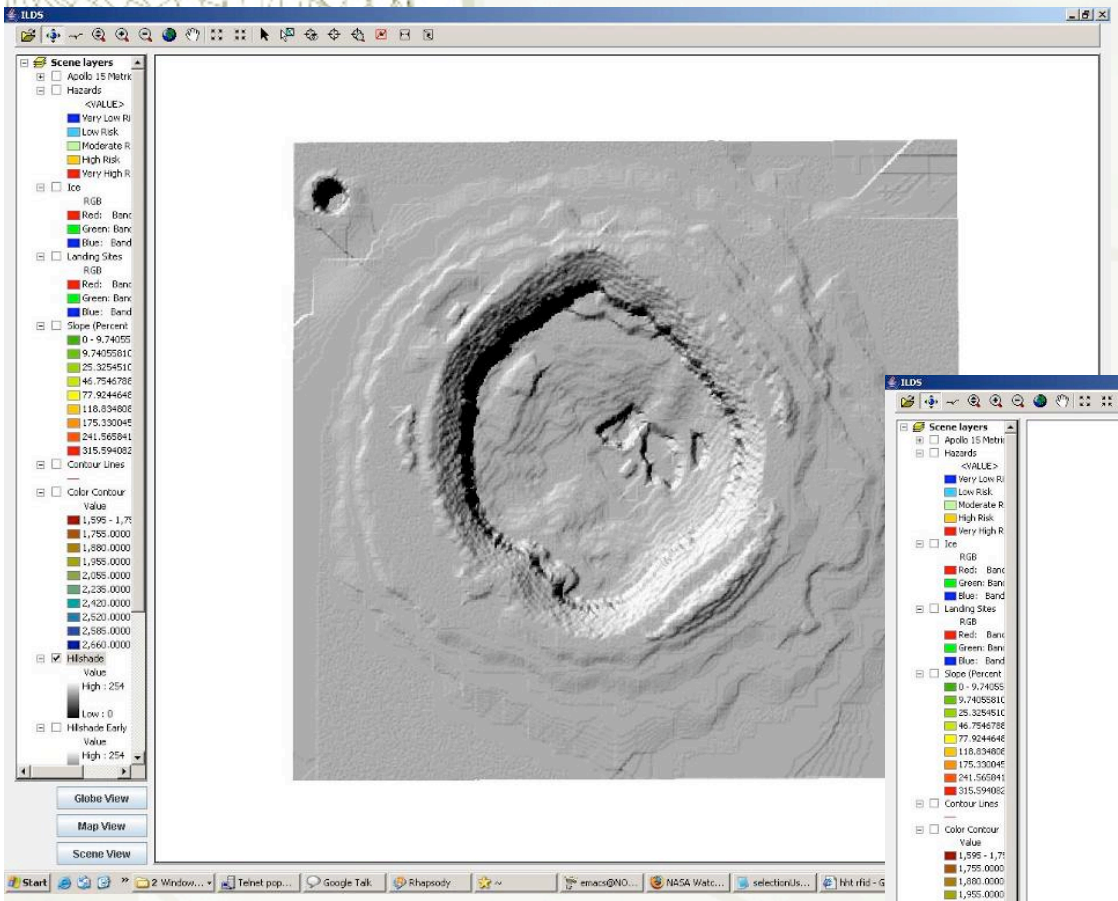

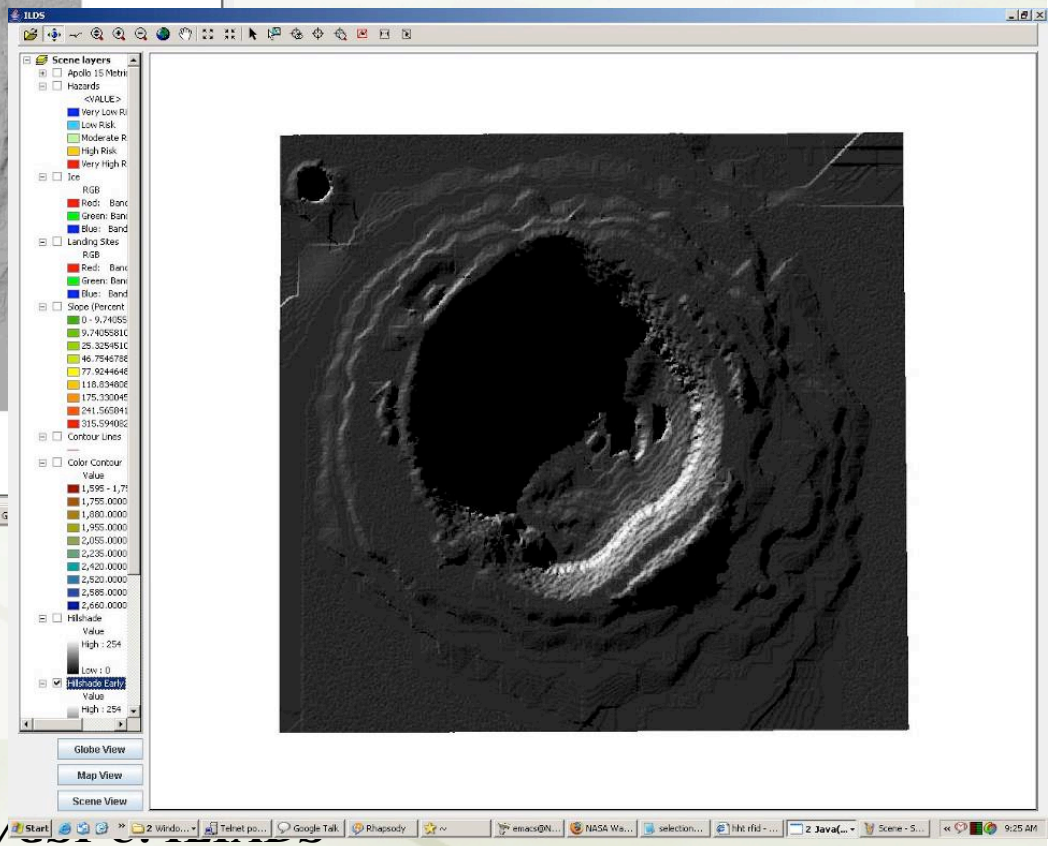

Topography

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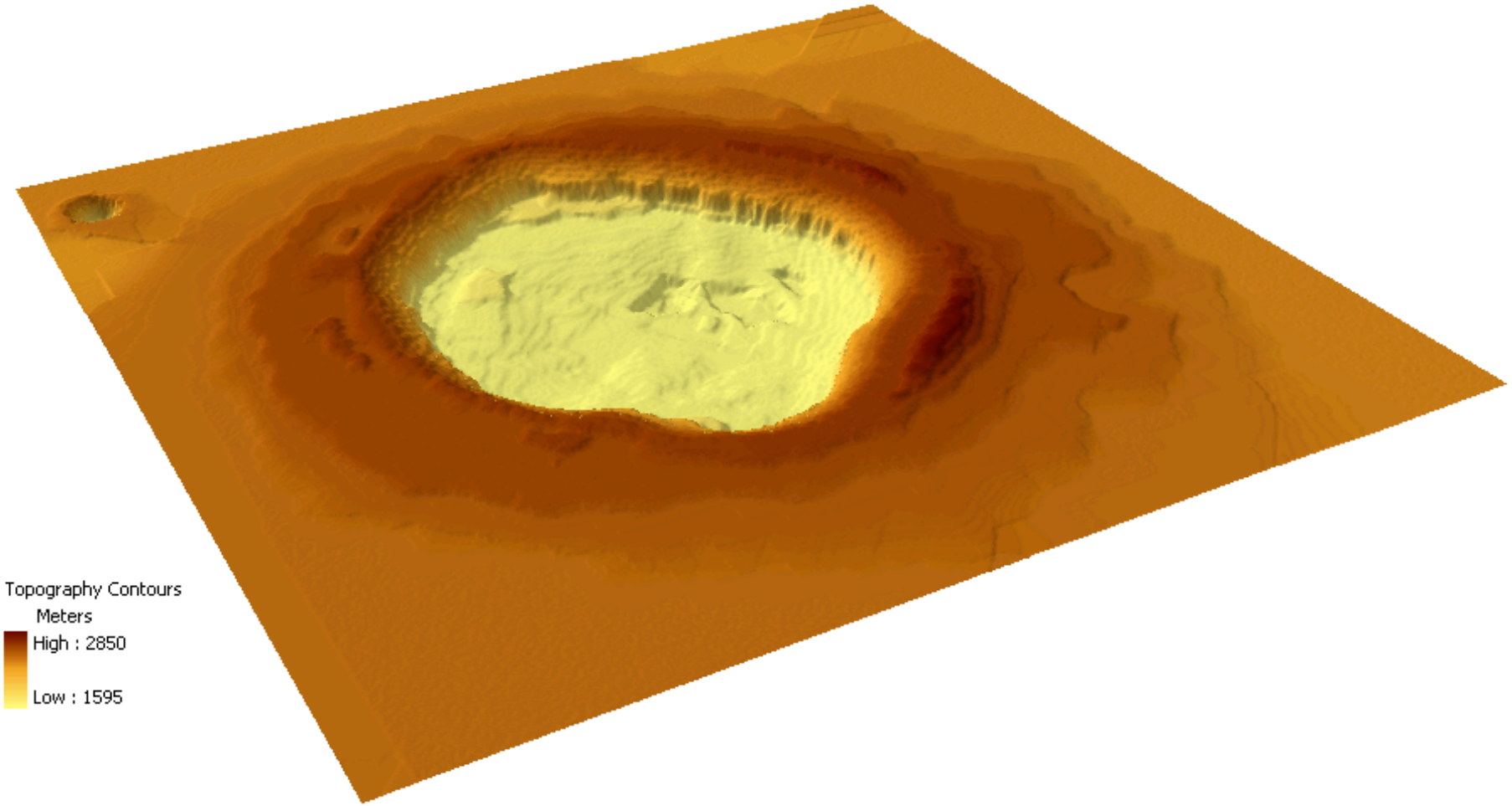
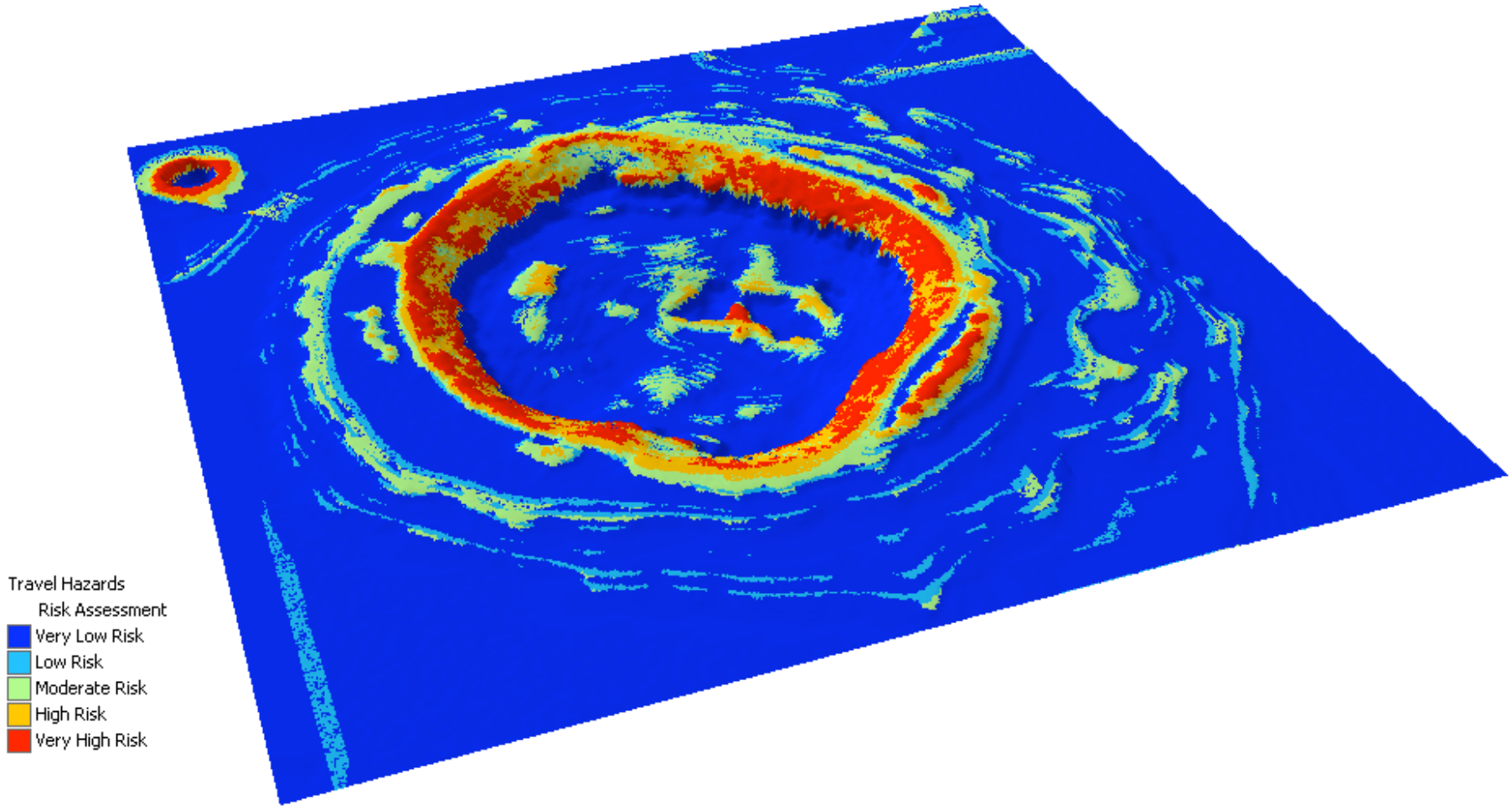


Hazard Analysis



LEND Neutron modeling

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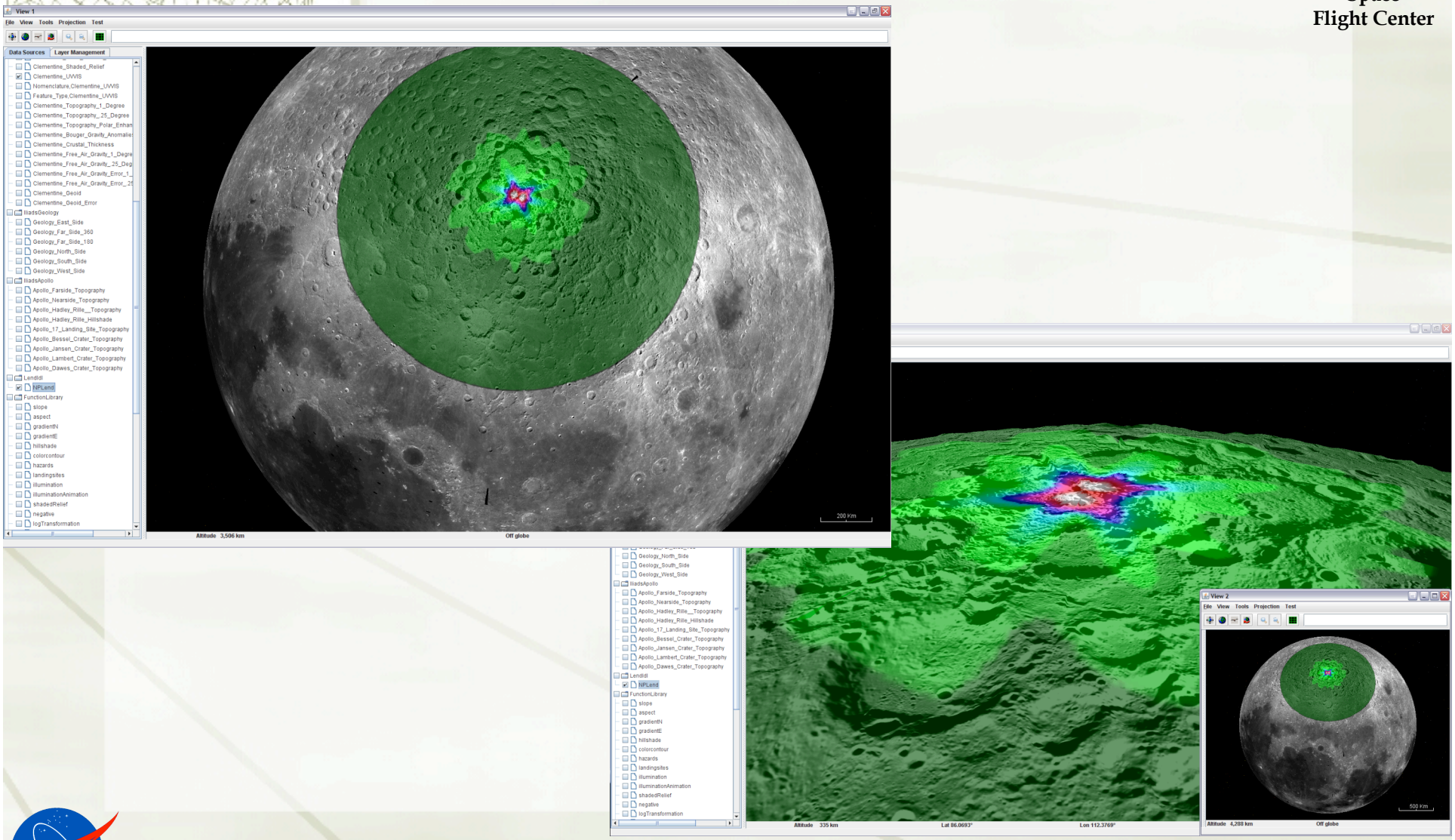

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